Processes and Products Characterizing Strata in the EuroSTRATAFORM Study Areas

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LONG-TERM GOALS

The ultimate goal of this research is to understand the mechanisms by which continental-margin sediment is deposited, modified and preserved, so strata recorded over various time scales (events to millennia) can be interpreted better.

OBJECTIVES

The fieldwork is undertaken on the Adriatic Italian margin within the larger context of the EuroSTRATAFORM program, and has objectives that complement those of other groups. In particular, this project is designed to document event beds (i.e., flood, storm) immediately after they form, to observe their subsequent modification and preservation, and to interpret geologic history from old beds buried at various depths within the seabed (10s of centimeters to meters). During the past year, these objectives were focused on the prodelta environment near the Po River and on the clinoform structure seaward of the Apeninne coast. These study areas provide the opportunity to fulfill the following objectives:

a) document the evolution of the 2000 Po flood deposit;

b) examine southward transition from point- to multiple-source sediment dispersal;

c) evaluate episodic input from Apennine Rivers and the historical change in their sedimentation;

d) study clinoform sedimentation, including formation of crenulations.

In addition, the overall EuroSTRATAFORM program is coordinated through efforts to: orchestrate program planning, organize field operations, and disseminate scientific results.

APPROACH

Rapid-response box coring occurred soon after a major flood of the Po River in autumn 2000. Subsequently, the adjacent continental shelf has been examined several times each year by box coring, and recently by kasten coring. Investigations of sediment size, composition and fabric are put into a chronologic context using a suite of radioisotopes (^{7}Be, ^{234}Th, ^{210}Pb, ^{137}Cs), which are relevant for a variety of time scales (months to decades).

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15. SUBJECT TERMS

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In April 02, studies were extended southward to the Apennine coast. Box and kasten cores were collected off the Chienti, Aso, Tronto, Pescara and Sangro Rivers and the Gargano Peninsula. Studies of these samples will provide a baseline for detailed observations during FY2003. They also provide an opportunity to investigate the transitions in sedimentation southward between the Po dispersal system and the inputs from multiple Apennine Rivers. The presence of a clinoform feature allows examination of the mechanisms of strata formation as they vary across an extremely important type of stratigraphic architecture.

WORK COMPLETED

During 2002, data was synthesized and research papers written for an earlier phase of this grant that focused on the inner shelf and canyon near the Eel River – in the STRATAFORM study area off northern California. In addition, three cruises were completed near the mouth of the Po River and along the Apennine coast, as part of EuroSTRATAFORM. The cruises included coring and water-column observations, which provided samples for analyses of radiochemistry, sediment texture/composition, and sedimentary structure. These analyses were started.

RESULTS

a) Po flood deposit - In October 2000, a 100-year flood of the Po River occurred. ^{7}Be, a short-lived radioisotope (half-life 53.3 days), was used to examine the thickness of the flood deposit during a cruise in December 2000. The deposit was found to have thicknesses up to 15 centimeters and was located immediately adjacent to the distributary channels at the river mouth. Without knowing the source function for ^{7}Be discharge, ^{7}Be thicknesses might be minimum estimates for true thicknesses of the flood deposit. The location of the deposit is linked to the low-energy conditions present in the Adriatic Sea at the time of flood sedimentation. The flood signature was identified in x-radiography (physical stratification), ^{7}Be (uniform activities), and grain size (high clay percent). The Po deposit differs significantly from deposits observed after floods of the Eel River (northern California). A major difference between the flood deposits is the location (at the Po River mouth; seaward and downstream of the Eel River mouth), which highlights the distinct difference in energy conditions of the Adriatic Sea and the North Pacific Ocean. Subsequent cruises have followed the fate of the Po flood layer, and have examined changes occurring during all seasons. These studies have found depositional layers exhibiting different trends than those observed soon after the flood. The causes of these differences could be related to varying influences of the deltaic distributaries and to subsequent transport and mixing of sediment. The significance of these seasonal variations for the longer-term sediment-accumulation pattern near the Po River can be observed (e.g., through use of ^{210}Pb geochronology; half-life 22.3 years) along the sediment dispersal path southward.

b) Apennine coast – The Po dispersal system appears to coalesce with the overlapping deposits of the Apennine rivers. Initial studies of accumulation rate show strata forming at variable rates (~5-15 mm/y), perhaps proportional to sediment input rates associated with proximal rivers. The accumulating sediment has a distinctly large amount of carbonate sediment (~30%) relative to the Po dispersal system (~4%), and this might impact the ability of ambient currents/waves to disperse sediment. The distribution of accumulation rates across the clinoform does not show a dramatic increase on the foreset region (as expected from observations elsewhere), and might indicate that modern sedimentary processes differ from those when the clinoform architecture was created. At least during the past half century, there appears to be a recognizable decrease in accumulation rate.

c) STRATAFORM coordination – Planning for the STRATAFORM final volume continued, and chapters are presently being sent for review. Preparations were orchestrated for cruises in October, January and April to the Adriatic Sea. Three planning workshops were held for EuroSTRATAFORM in January (Bologna), June (Seattle), and September (Winchester, UK).

IMPACT/APPLICATIONS

Sedimentary studies in the Adriatic Sea provide a valuable contrast to the mountainous collision margin off the Eel River. In particular, they allow examination of sedimentation associated with the following characteristics.

- For the Po dispersal system: a larger drainage basin, less energetic receiving basin, deltaic sedimentation, and an epicontinental shelf.

- For the Apennine dispersal system: multiple river sources, significant carbonate content, clinoform stuctures, and significant anthropogenic impact.

These provide more comprehensive sedimentary systems to be observed and modeled, so our conceptual and numerical models have broader application.

TRANSITIONS

The research results are being utilized by numerous other EuroSTRATAFORM groups; for example, those studying: the seabed, because radioisotopic and sedimentologic profiles are part of the integrated effort to document seabed characteristics; boundary-layer hydrodynamics, because observations document the seabed at instrument sites; plume dynamics, because flood deposits demonstrate the fate of plume sediment; stratigraphic modeling, because sediment accumulation rates and budgets are important parameters.

RELATED PROJECTS

Examples of the related projects are: R. Wheatcroft, P. Hill, T. Milligan, seabed studies; A. Ogston, P. Puig, C. Sherwood, and P. Traykovski, boundary-layer hydrodynamics; R. Geyer, plume dynamics; and Miserocchi/Langone, organic distribution. The entire EuroSTRATAFORM program is related to the efforts for program coordination.

PUBLICATIONS

Palinkas, C., C. Nittrouer, R. Wheatcroft, L. Langone, S. Miserocchi, A. Ogston, A. Fain, 2002. Seasonal deposition of sediment near the mouth of the Po River. EOS, Transactions, v. 83, OS17.

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Mullenbach, B.L., C.A. Nittrouer, and Puig, P., submitted. Sediment deposition in a modern submarine canyon: Eel Canyon, northern California. *Mar. Geol.*

Mullenbach, B.L., A.S. Ogston, C.A. Nittrouer, P. Puig, E. McPhee, about to be submitted. Processes controlling off-shelf sediment export via nepheloid layers on the Eel continental margin, northern California: open slope versus submarine canyon. *Cont. Shelf Res.*

Puig P., A.S. Ogston, B.L. Mullenbach, C.A. Nittrouer, R.W. Sternberg, in press. Shelf-to-canyon sediment-transport processes on the Eel continental margin (northern California). *Mar. Geol.*